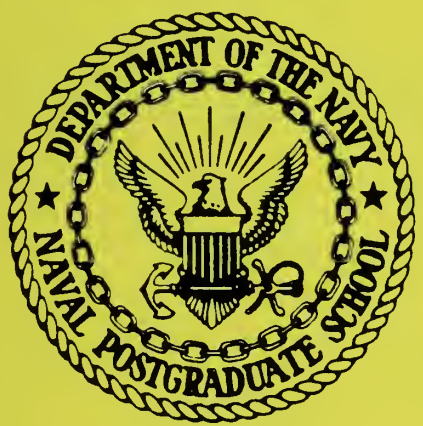
NPS 61-86-015PR

NAVAL POSTGRADUATE SCHOOL

Monterey, California



REVIEW OF INTERACTIONS BETWEEN
THE NAVAL POSTGRADUATE SCHOOL
AND
THE NAVAL UNDERSEA WARFARE ENGINEERING STATION
1973-1986

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June 1986

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Monterey, CA 93943-5000

NAVAL POSTGRADUATE SCHOOL
Monterey, California

Rear Admiral R. C. Austin
Superintendent

D. A. Schrady
Provost

This report was prepared as a review of research at the Naval Postgraduate School supported by the Naval Undersea Warfare Engineering Station and of other interactions between the two commands over the period of 1973 - 1986.

This report was prepared by members of the NPS-NUWES steering committee:

Naval Postgraduate School members:

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REVIEW OF INTERACTIONS BETWEEN THE NAVAL POSTGRADUATE SCHOOL AND THE NAVAL UNDERSEA WARFARE ENGINEERING STATION 1973-1986

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Naval Postgraduate School

and

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Naval Undersea Warfare Engineering Station

June 1986

SUMMARY

A review has been made of the interactions between the two commands since 1973, the results have been evaluated, and several recommendations are provided. Total amount of support is $1.7 million.

PRODUCTS

Number of separate projects 40

Number of reports 49

Number of student theses 62

Number of student experience tours 7

Number of faculty involved in projects 33

About 10 field trips of students from the ASW and UX Curricula

FINDINGS

It is concluded that the interactions between NUWES and NPS have been favorable for both commands and have met the objectives of the Memorandum of Agreement. The interactions should be continued.

RECOMMENDATIONS

1. That the method of operations not be changed at this time.
2. That the amount of support not be changed significantly at this time.
3. That improvements be made by:

Encouraging NUWES to send one or more of their younger engineers to NPS for advanced study and perhaps an advanced degree.

Encouraging more NPS faculty to make extended visits to NUWES.

Exploring new technical areas for interaction.

TABLE OF CONTENTS

1. INTRODUCTION.

This report is provided as part of the briefing for our respective commands which (a) reviews the results of interactions of our institutions since the signing of the agreement in 1973 and (b) makes recommendations for the future. The following paragraphs provide background information, evaluations, discussion, and recommendations for future actions. Details of the interactions are provided in the Appendices.

2. BACKGROUND.

The formal relations between the two institutions began with a visit to the Naval Postgraduate School (NPS) in October 1972 by CAPT Jack L. Carter, Commanding Officer, and Mr. Edward H. Lesinski, Technical Director, of the Naval Undersea Warfare Engineering Station, Keyport, (NUWES) (then the Naval Torpedo Station) for the purpose of discussing prospective interactions. A visit to Keyport in February 1973 of NPS Dean of Research, J. Wozencraft, with several faculty members, then led to plans for prospective tasks of mutual interest and the signing of a Memorandum of Agreement (Appendix A) in June 1973. A faculty group, headed by Prof. C. E. Menneken, which had been engaged in studies in Anti-Submarine Warfare, submitted a proposal to NTS in July. The efforts during the first full year of involvement, FY 1974, involved sixteen faculty members from six academic departments, and was devoted mainly to familiarization of these faculty members with problems at Keyport. After initial study periods, effort in subsequent years was devoted to specific tasks, students became involved through faculty-guided thesis projects and experience tours, and a few faculty members spent periods of time at Keyport working on projects and giving short courses of instruction or presenting lectures. During the last ten years, NUWES has hosted annually a two-day field trip for students and faculty in the Anti Submarine Warfare and Underwater Acoustics Curricula. A brief chronicle of activities during these years is

provided in Appendix B. A listing of some of the products of these interactions, namely reports and student theses, is given in Appendices C and D. Appendices E and F list student experience tours and faculty participants.

3. METHOD OF OPERATION.

A. Since 1973, NUWES and NPS have operated in accordance with the Memorandum of Agreement (Appendix A) under which selected faculty of the School and their students, when consistent with the academic program, undertake the solution of selected appropriate problems faced by the Station in its long-range planning and development. The Station in turn makes, within operational constraints, its facilities available and provides fiscal support to the investigators at the School. Generally, the problems have been specific and of long-term importance to the Station. Studies have been conducted in a number of areas which include: tracking errors in acoustic ranging, clock pulse coding, clock transducer development, Kalman filter applications to range tracking, range data display methods, computer requirements, radio-frequency propagation effects, acoustic measurements related to TRIDENT, measurement problems in magnetic properties of submarines, acoustic properties of sediments, acoustic imaging systems for torpedo recovery, torpedo track smoothing and fiber-optic technology for data transmission.

B. ORGANIZATION.

In early years, work done under NUWES sponsorship was performed by several small groups of faculty members from various disciplines and their students. For the past several years, responsibility for task accomplishment has been placed in the hands of an individual faculty member. An omnibus proposal is prepared each year by the NPS members of the steering committee with task statements provided by the individual investigators. Arrangements at NUWES provide for personal contact and task guidance for each task by an individual there who has a direct interest in the product of the research work. In many

cases, student involvement in the task efforts has continued, as it was before, to be in the form of a M.S. degree thesis project, carried out under the guidance of the faculty member. Overall coordination has been carried out by a steering committee composed of two individuals from each command.

C. REPORTS.

Results of work under the agreement are reported in several ways. Technical reports and student theses are submitted at the completion of task efforts. Informal reports of progress and results are often given during visits of faculty and students to Keyport. In addition, Keyport steering committee members visit NPS twice a year to review progress. An annual summary report is made after the end of the fiscal year.

4. EVALUATIONS.

A. VALUE TO NPS.

The arrangements with NUWES have provided a stable source of research support which has had the following advantages for NPS:

* The tasks are generally interesting applied science or engineering problems.

* The tasks are relevant to Navy needs and this relevancy makes the problems interesting to our students for thesis projects.

* The tasks generally help fulfill both missions of NPS, thesis work which provides learning experience in an area relevant to our primary mission, and research in support of that mission.

* The association has provided opportunities for both faculty and students to make field trips to Keyport which have valuable educational benefits for both faculty and students in the area of underwater weapons testing and evaluation.

* The association has also provided an opportunity for faculty growth through involvement with real-world Navy technical problems.

* There have also been a number of brief visits by NUWES engineers to NPS for the purpose of delivering lectures or seminars for our faculty and students.

B. VALUE TO NUWES.

NUWES established the present working relationship to gain access to the technical thought, innovative talent, and record of accomplishment represented at the Naval Postgraduate School. The Station also wanted to provide officer students with an opportunity to become better acquainted with NUWES and engage in relevant thesis research on our projects. We believe that the association has accomplished these original goals very well. We have established a long term relationship with a cadre of faculty and there are yearly student visits to the Station. Each year, we also have several students involved in experience tours and/or related thesis work.

5. DISCUSSION AND RECOMMENDATIONS.

A. METHOD OF OPERATION. The method of operation has, from the beginning, involved a steering committee of four, two from each command, which has monitored and controlled task assignments, resource allocations, and other activities. The question arises, should the method of operations be changed? The options for change are limited. One possible change would be to require individual proposals from each Principal Investigator with Work Requests from individual coordinators at NUWES. From the steering committee's point of view, the present method seems to work well. It provides a considerable amount of flexibility and a reasonable amount of control. <u>It is recommended that the method of operations not be changed at this time</u>.

B. SUPPORT. During the thirteen years of the interaction, the total support provided NPS by NUWES amounts to $1.7 million. The annual amount has grown only slightly in this time. With the present limitations on NPS civilian billets, it would be difficult to provide much more faculty time to the

projects. It is recommended that the amount of support not be changed by any significant amount at this time.

C. IMPROVEMENTS. Improvements in our interaction could be increased along the lines described below:

(1) NUWES could send one or more of their younger engineers to NPS for advanced study and perhaps an advanced degree. Advantages: NPS has some unique educational programs in NUWES' line of work. The civilian engineer would be associating with professional Naval officers and learning something about the Naval Officer's point of view on many aspects of technical problems.

(2) Efforts should be made to encourage more NPS faculty to make extended visits to Keyport (i.e., longer than one or two days). The advantages would be closer interaction, real world experience at a Naval shore activity, and opportunities to give short courses or lectures.

(3) It is recommended that we explore new technical areas for interaction since there has not been much interaction outside the departments of Electrical and Computer Engineering, Operations Research, and Physics.

D. MEMORANDUM OF AGREEMENT. The Memorandum of Agreement, although thirteen years old, is considered to be pertinent and not in need of change.

APPENDIX A

MEMORANDUM OF AGREEMENT

The Naval Torpedo Station
and
The Naval Postgraduate School

1. PURPOSE

This agreement between the Naval Torpedo Station, Keyport, and the Naval Postgraduate School, Monterey, is for the purpose of establishing a continuing cooperative program whereby in furtherance of the NPS mission Monterey faculty members and officer students can pursue research projects related to the solution of long-range technical problems inherent in the NAVTORPSTA mission.

2. NATURE OF PROJECTS

The type of projects to be undertaken under this agreement are as follows:

2.1 Conception of advanced systems in areas which support the NAVTORPSTA mission.

2.2 Scientific and engineering research appropriate to validate proposed systems.

2.3 When compatible with mission and operational programs of both the NAVTORPSTA and the NPS, specific tasks of more limited scope which relate to projected NAVTORPSTA programs. Projects of the emergency variety are specifically excluded.

2.4 The projects are generally to be unclassified. However, both parties agree that the publication of any given information will have to be approved by proper authority, that some work may not be declassifiable, and that access to classified information will be necessary in areas which support the NAVTORPSTA mission.

3. TIME FRAME

3.1 In keeping with the long range nature of the intended association, the term of the agreement is indefinite. However, it is planned that the parties re-evaluate and reaffirm the agreement every two years.

3.2 The terms of participation by individuals working on the program are also indefinite. It is expected that valuable participation can be obtained with assignments having terms as short as a few months or as long as 1 to 2 years.

4. BENEFITS

4.1 The NAVTORPSTA expects to gain the following benefits from the association defined by this agreement.

4.1.1 Access to technical thought, innovative talent and background of accomplishment that are present at the Naval Postgraduate School.

4.1.2 An opportunity to acquaint research scientists and engineers with the long-range technical problems related to the Station's mission, and to interest and involve them in their solution.

4.2 For the Naval Postgraduate School this cooperative program is consistent with its statement of mission, in which research is identified as supporting excellence in officer education. In addition, the Naval Postgraduate School will gain added opportunity for its faculty to maintain their professional growth, enrich classroom instructional programs for its officer students and especially provide its officer students the opportunity to engage in relevant Navy-oriented thesis research, specifically ASW operational and test and evaluation problems peculiar to the Naval Torpedo Station's technical tasks.

5. ORGANIZATION

5.1 Coordinating Group. The Superintendent of the Naval Postgraduate School and the Commanding Officer of the Naval Torpedo Station shall each appoint two persons to serve together as a program Coordinating Group. Appointees will be selected for continuity and relevant interest and expertise. Appointments shall be for a two year term.

5.2 The Coordinating Group will represent the Superintendent and the Commanding Officer in the management of approved tasks. It will also review and recommend proposals for tasks to be included in the cooperative program, review progress (annually or more frequently as required), recommend funding support, validate purchase of major project items, approve minor and recommend significant modifications to plans, and recommend the assignment of personnel. In addition, they shall review specifications for any contracts to be let in support of the work covered by this agreement, provide security

classification guidance, and transmit written material proposed for publication for higher level approval when necessary.

6. IMPLEMENTATION

6.1 Personnel. NPS faculty and officer students may be assigned to spend specific periods of time working at the Naval Torpedo Station, the Naval Postgraduate School, or such other locations as agreed to for periods from several months to a year. It is anticipated that certain NAVTORPSTA professional and technician staff members may be beneficially or necessarily employed in project work at NPS and elsewhere. Personnel will remain in billets assigned to their present organizations. Both organizations will establish points of contact (liaison) for project action and support, and for military matters.

6.2 Funding and Support.

6.2.1 NAVTORPSTA provided. The NAVTORPSTA will pay direct costs of the project including:

6.2.1.1 Salaries (including fringe benefits) of faculty and technicians.

6.2.1.2 Travel and per diem expenses.

6.2.1.3 Major material items including contracts.

6.2.1.4 Procurement of required special equipment or instrumentation not available at either NAVTORPSTA or NPS as approved by the Coordinating Group.

6.2.1.5 Title to any purchased equipment will be determined prior to its procurement in accordance with applicable regulations and the policies of both commands.

6.2.2 Jointly provided. Both commands will, as appropriate, provide the following:

6.2.2.1 Housekeeping facilities (office, laboratory space, phone, power, etc.)

6.2.2.2 Shops and special technical and ranging services.

6.2.2.3 Computer time in support of the projects.

6.2.2.4 Use of laboratory equipment and instruementation when not otherwise required for operational or instructional use.

6.2.2.5 Limited clerical and technician support.

6.3 Proposals

6.3.1 The NPS will prepare a general proposal, preferably to cover a two to three year plan, with annual updates. The proposal will be reviewed by the Coordinating Group, and submitted through channels for approval. The NPS will organize and assign specific tasks consistent with the general proposal to faculty and officer student participants to engage in analytical and experimental work as determined to be necessary. It is recognized that NPS must have considerable flexibility of operation in view of the great variation and unpredicability of the student load, course requirements, and teaching assignments.

6.3.2. Proposals for additional tasks to be included in the cooperative program will be accepted at any time from either command for consideration by the Coordinating Group.

7. PUBLICATIONS AND REPORTS

7.1 It shall be the policy of both parties to encourage, support and facilitate the publication of project results. The Coordinating Group will assist in obtaining the necessary approvals.

7.2 The NPS will provide an annual report for submission to both NAVTORPSTA and NPS commands. Additional reports will be provided as desirable or appropriate. Reports for wider circulation will be approved by both commands prior to release.

APPENDIX B

A BRIEF CHRONICLE OF NUWES-NPS INTERACTIONS

FY 1973

In October 1972, the Naval Torpedo Station's Commanding Officer, CAPT Carter, and Technical Director, Mr. Lesinski, visited the Naval Postgraduate School to discuss prospects for NTS-NPS interactions. This led to visits to Keyport, in February 1973 by Dean of Research Wozencraft and several faculty members to consider various means of interaction, and then in April, by another faculty group, headed by Prof. Menneken, for briefings on Keyport's technical problems. Finally, in June of 1973, a Memorandum of Agreement between the Postgraduate School and the Station was signed in Monterey by the Superintendent, RADM Freeman, and the Commanding Officer, CAPT Carter.

FY 1974

The first proposal from NPS to NTS for studies on Range Problems was submitted. The group of faculty writing the proposal, headed by Prof. Menneken, had been involved in ASW studies. The amount proposed for the first year of study effort was $100,000. Sixteen faculty members from six academic departments participated. The effort was mainly devoted to familiarization with Keyport's problems.

FY 1975

Seventeen faculty members were involved. Although some of the effort was still directed to familiarization, specific tasks were taken up and four student theses were completed. Prof. Carl Menneken passed away during this year. Total funding was $137,000.

FY 1976

A total of ninteen faculty members participated in the range studies efforts. Prof. Washburn spent a summer intersessional period in residence at Keyport. Six student theses were completed. Funding level was $85,000.

FY 1977T and FY 1977

The number of faculty participants was fifteen. Ten student theses and several project reports were completed. Total funding was $110,000.

FY 1978

Faculty participants numbered eleven. Four student theses and several technical reports were completed. Funding level was about $135,000.

FY 1979

Six student theses were completed and the first student experience tour was carried out by LT P. Ward. Prof. G. Cantin spent part of an intersessional period in residence at Keyport.

FY 1980

Eight faculty members were involved with the Keyport project this year. Two student theses were completed. LT Thackery was assigned to the Hawaii Detachment of NUWES for an experience tour. Funding level was $120,000.

FY 1981

Three of Prof. J. Power's students completed their thesis work during this year. Nine faculty members participated in various tasks. LT J. Miller was at Keyport for her experience tour. Funding level was $120,000.

FY 1982

Funding level for this year was $150,000. Eleven members of the faculty were participants in the effort. Four student theses were completed and LT Hudson spent his experience tour at Keyport. Prof. Esary made an extended visit to NUWES in November.

FY 1983

Nine faculty members were involved this year. Eight theses were completed involving thirteen students. Funding level was $150,000.

FY 1984

Funding level for this year was $165,000, which supported tasks involving eleven faculty members. Five student theses were completed during the year.

FY 1985

Again, the number of faculty involved was eleven. Six students completed their theses during this year. Support amounted to $158,000. Part of the experience tours of LT Morrison and LT Harrelson was spent in Keyport.

FY 1986

Funding for the current year is $150,000. Ten faculty members are involved in projects. Two students are currently spending experience tours at Keyport, LT Niemann, ASW Curriculum, and LT Biesel, Operations Analysis Curriculum.

APPENDIX C

LIST OF PROJECTS

Range Requirements:
1975 Bank, Cunningham, Stentz, Wilde
1976 Bank, Cunningham, Stentz, Wilde

Signal Coding:
1975 Hoisington, Myers, Powers, Sackman
1976 Hoisington, Myers

Ray Tracing:
1975 Coppens, Dahl, Sanders, Wickham
1976 Coppens, Dahl, Sanders, von Schwind

Information Transmission, Processing, and Display:
1975 Bank, Powers, Sackman
1976 Bank, Cotton, Panholzer, Powers, Sanders, Sackman, Wilde

Transducers:
1976 Coppens, Sackman, Stentz, Wilson
1977 Sanders, Wilson

Range Concepts:
1976 Coppens, Cotton, Washburn, Wilson
1977 Stentz, Titus, Washburn, Wilson

Non-Acoustic Sensors:
1976 Bank, Hoisington, Sackman

Electromagnetic Propagation:
1976 Knorr
1977 Knorr
1978 Knorr
1979 Knorr
1980 Knorr
1981 Knorr
1983 Knorr

Computer Algorithms and Displays:
1977 Coppens, Cotton, Dahl, Powers
1978 Cotton

Trident Impact-Acoustics:
1977 Sanders, Wilson

Trident Impact-Magnetics:
1977 Bank, Hoisington, Sackman

Acoustic Ranging Algorithms:
1978 Coppens, Dahl

Kalman Filtering Applications to Range Tracking:
1978 Titus, Washburn
1979 Titus
1980 Titus
1981 Titus
1982 Titus
1983 Titus, Gerba
1984 Titus, Gerba
1985 Titus, Gerba
1986 Titus, Gerba

Adaptive Acoustic Processing:
1978 Sackman, Stentz

Measurement of Acoustic Source Levels in a Reverberant Environment:
1978 Sanders

Clock Transducer Development:
1978 Wilson
1979 Wilson

Measurement of Acoustic Source Levels Using Surveillance Arrays:
1978 Sackman, Wilson

Acoustic Imaging Techniques:
1978 Sackman, Wilson

Torpedo Path Estimation:
1978 Tysver
1979 Tysver
1980 Tysver
1981 Tysver, Read
1982 Tysver
1983 Tysver
1984 Tysver
1985 Tysver
1986 Tysver

Acccuracy Improvement Tests for Sonar and Weapons Systems:
1979 Stentz
1980 Stentz
1981 Stentz
1982 Stentz
1983 Stentz
1984 Stentz
1985 Stentz

Development of an Acoustic Image System for Use in Torpedo Recovery:
1979 Sackman
1980 Sackman
1981 Sackman
1982 Sackman
1983 Sackman

Measurement of Acoustic Properties of Sediments:
1979 Wilson

SFSK Coding Methods:
1980 Myers

Fiber Optic Applications in Underwater Range Applications:
1980 Powers
1981 Powers
1982 Powers
1983 Powers
1984 Powers
1985 Powers

Surface Interference Effects on Underwater Acoustic Measurements:
1980 Sackman, Wilson

Experiments on Anti-Reflection Coatings:
1980 Wilson

Measurements of Directionality of Ambient Noise:
1981 Dahl, Wilson

Range Calibration Studies:
1982 Read
1983 Read
1984 Read
1985 Read
1986 Read

Reliability and Performance Studies:
1982 Esary
1983 Esary
1984 Esary
1985 Esary, Forrest
1986 Esary

Applications of Robotics and Alternate Energy Sources at NUWES:
1982 Sackman

Design Studies on Steerable Small Aperature Directional Hydrophone Arrays:
1982 Dahl, Wilson

Application of Acoustic Surface Interference Effects to Passive Tracking:
1983 Wilson

Operations Research Approaches to the Sonar Calibration Problem:
1984 Gaver
1985 Gaver

Multipath Measurement System Development:
1984 Wilson
1985 Wilson

Speech Recognition,
1984 Poock

Improving Accuracy in Determining the Location of On-Board Transponders:
1984 Goldstein, Russak
1985 Goldstein, Russak

Parametric Sonar in Sediments:
1985 Yoon, Wilson
1986 Yoon, Coppens, Wilson

Portable Range Studies:
1986 Stentz

Operation Research Models and Artificial Intelligence:
1986 Gaver

Digital Processing for Image Enhancement of Underwater Objects:
1986 Therrien

APPENDIX D

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Range Studies Group, August 1974.

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A. R. Washburn, Internal Working Paper, Fall 1974.

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G. A. Myers, Internal Working Paper, July 1975.

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Simulation of a Kalman Filter Used for Long Baseline Underwater Tracking,
A. R. Washburn, Technical Report NPS-55Ws-75-101, October 1975.

Design of an Electrical Circuit Used to Simulate Sea Water as a Sonar Signal Propogation Medium,
G. A. Myers, Letter Report, December 1985.

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M. H. Bank, Technical Report NPS-71Bt-77-021, February 1977.

Magnetic Ranging and Magnetic Sensors for the TRIDENT Program (U), CONFIDENTIAL,
D. B. Hoisington, Technical Report NPS-62Hs-77-031, February 1977.

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D. A. Stentz, Technical Report NPS-62Sz-77-071, July 1977.

Future Magnetic Ranging Requirements for TRIDENT and the Feasibility of Simultaneous Magnetic and Acoustic Ranging (U), SECRET
G. L. Sackman, Technical Report NPS-62Sa-77-111, November 1977.

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Review of AAI Corporation Reports on MAPS,
A. B. Coppens and O. B. Wilson, Jr., Letter Report, January 1978.

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D. A. Stentz, Technical Report NPS-62-78-003, March 1978.

Comparisons of Isogradient and Isospeed Layer Models for Ray Tracing,
A. B. Coppens, Technical Report NPS-61-78-004, April 1978.

Smoothing 3-D Data for Torpedo Paths,
J. B. Tysver, Project Report NPS-55-78-036PR, May 1978.

Simulation of a Kalman Filter Used for Short Baseline Underwater Tracking,
A. R. Washburn, Technical Report NPS-55-78-015, July 1978.

A Radiowave Propagation Data Acquisition System,
J. B. Knorr, Technical Report NPS-62-79-001, October 1978.

Recommendations for Immediate Modifications to Hydrostatic Testing Facility at the Naval Undersea Warfare Engineering Station at Keyport,
J. E. Brock, Letter Report, November 1978.

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O. B. Wilson, Jr. (Editor), Project Report NPS-61-79-001PR., November 1978.

Interim Report on Hydrostatic Test Vessels at Naval Undersea Warfare Engineering Station, Keyport, Washington,
J. E. Brock, Letter Report, February 1979.

Improvements in Accuracy Tests for Sonar and Weapons Systems,
D. A. Stentz, Letter Report, April 1979.

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J. B. Tysver, Project Report NPS-55-79-012PR, May 1979.

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R. R. Read, Letter Report, January 1983.

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G. K. Poock, Memorandum, August 1984.

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R. R. Read, Letter Report, September 1984.

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O. B. Wilson, Jr. and J. D. Esary (Editors), Project Report NPS-61-85-001PR, October 1984.

A Figure of Merit for NUWES Data,
J. B. Tysver, Project Report NPS-55-85-010PR, May 1985.

Investigating the Accuracy in Determining the Location of On-Board Transponders,
I. B. Russak and A. A. Goldstein, Technical Report NPS-53-84-0008, May 1985.

A Dual Launch Torpedo Effectiveness Estimation Method,
R. N. Forrest, Technical Report NPS-55-85-022, September 1985.

Annual Summary Report, Range Studies Program,
O. B. Wilson, Jr. and J. D. Esary (Editors), Project Report NPS-61-86-003PR, October 1985.

Program for the Simultaneous Estimation of Displacement and Orientation Corrections for Several Short Baseline Arrays,
R. R. Read, Technical Report NPS-55-85-028, November 1985.

Transformation of Displacement and Orientation Correction Data,
G. Gygax and R. R. Read, Technical Report NPS-55-85-031, December 1985.

A Seven Point Smoothing Program for NUWES Data,
J. B. Tysver, Project Report NPS-55-86-003PR, January 1986.

Versatile Six Sensor Acoustic Tracking Range for Determining Performance Characteristics of Hull Mounted and Towed Sonar,
P. A. Stentz, Technical Report NPS-62-86-002, March 1986.

APPENDIX E.

LIST OF THESES PUBLISHED

All theses are for the Master of Science degree at the Naval Postgraduate School, in a curriculum shown following the author's name.

An Investigation of Binary Codes for Underwater Tracking Systems,
R. H. Schmidt (USMC), Electrical Engineering, September 1974, Advisor: Powers.

Models for Computing the Directional Radiation of Sound from Sources on a Rigid Cylindrical Baffle,
R. R. Johnson (USN), Engineering Acoustics, December 1974, Advisor: Wilson.

Ray Trace Experiment on the Underwater Range at Dabob Bay,
S. C. Karon (USN), Engineering Acoustics, December 1974, Advisor: Sanders.

An Analysis of a Ray Trace Experiment on the Underwater Range at Dabob Bay,
V. J. Bankston (USN), Systems Technology, March 1975, Advisor: Sanders.

Design Approach for a Computer Graphics System Applicable to Torpedo Tracking and Evaluation,
L. N. Schofield (USN), Computer Science, June 1975, Advisor: Powers.

Radiation Pattern Shaping of a Two-Element, Concentric Ring Transducer using Phase and Amplitude Shading,
A. H. P. Shaw (Canadian Forces), Engineering Acoustics, December 1975, Advisor: Wilson.

Solid-State Digital In-Situ Acoustic Data Acquisition,
D. M. Craig (USN), Electrical Engineering, December 1975, Advisor: Powers.

Torpedo Tracking Using an Onboard Tracking System,
A. E. Taylor (USN), Systems Technology, March 1976, Advisor: Wilson.

On the Measurement of Operational Performance of the Trident Sonar System (U), CONFIDENTIAL,
H. A. Bunch (USN) and R. G. Lacher (USN), Systems Technology, March 1976, Advisor: Sackman.

Computer Prediction of Tropospheric Radio Transmission Loss for Selected Paths in the Pacific Northwest,
R. M. Cassidy (USN), Electrical Engineering, June 1976, Advisor: Knorr.

The Design of a User Interface for a Color, Raster Scan Graphics Device,
R. L. Nesslage (USMC), Computer Science, June 1976, Advisor: Raetz.

Surface Search Radar Tracking by a Microcomputer Kalman Filter,
C. H. Wilson (USN), Electrical Engineering, September 1976, Advisor: Powers.

On the Use of Color in Raster Scan Graphics,
M. E. Bisgrove (USN), Computer Science, December 1976, Advisor: Powers.

The Kalman Filter Applied to Process Range Data of the CUBIC Model 40 Autotape System,
B. E. Julian (USN), Electrical Engineering, December 1976, Advisor: Titus.

An Application of Kalman Filtering to Underwater Tracking,
E. J. Benson (USN), Applied Science, December 1976, Advisor: Titus.

Development of a Concentric Piston Transducer for Tracking Underwater Vehicles,
V. U. Auns (Canadian Forces), Engineering Acoustics, December 1976, Advisor: Wilson.

Development of a Flexural Disk Transducer for Acoustic Tracking of Underwater Vehicles,
O. Sevdik (Turkish Navy), Engineering Acoustics, December 1976, Advisor: Wilson.

An Experiment Using Refractive Properties of an Encapsulant to Alter the Sound Radiation Pattern in a Small Flush-Face Transducer,
A. L. Ford, III (USN), Engineering Acoustics, December 1976, Advisor: Wilson.

Measurement of Low Frequency Acoustic Reverberation in Dabob Bay, I. Description of Procedures and Data Analysis,
M. E. Elsen (USN), Systems Technology, March 1977, Advisor: Wilson.

An Evaluation of a Portable Underwater Tracking Range (U), SECRET NF
S. H. Brennan, Jr. (USN), Systems Technology, March 1977, Advisor: Wilson.

The Statistics of Multipath Fading at VHF Applied to Communications Links at NAVTORPSTA Keyport, Washington,
G. R. Westling (USCG), Electrical Engineering, September 1977, Advisor: Knorr.

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D. T. Wetters (USCG), Electrical Engineering, September 1977, Advisor: Knorr.

Measurement of Radiated Noise in a Reverberant Environment,
G. H. Santillan (Argentine Navy), Engineering Acoustics, December 1977, Advisor: Sanders.

Experimental Investigation of the Effects of Fluid Loading on Flexural Waves in Plates,
J. L. Jarvis (USN), Engineering Acoustics, December 1977, Advisor: Wilson.

An Investigation of the Potential Use of Acoustic Surveillance Arrays for Submarine Radiated Noise Source Level Measurements (U), SECRET
J. H. Long (USN), Systems Technology, March 1978, Advisor: Wilson.

A Portable Three-Dimensional Graphics Software Package,
H. J. Rood (USN), Electrical Engineering, September 1978, Advisor: Cotton.

Real Time Kalman Filtering for Torpedo Range Tracking,
D. Dwyer (USN), Electrical Engineering, December 1978, Advisor: Titus.

Comparison of Theoretical and Experimental Sound Radiation Patterns from a Water Loaded Flexural Disk Transducer,
T. O. Kiyar (Turkish Navy), Engineering Acoustics, December 1978, Advisor: Wilson.

Fiber Optic Design Application for a Shallow Water Torpedo Tracking Range,
J. R. McHenry (USA), Electrical Engineering, March 1979, Advisor: Powers.

Remote Aquisition of Atmospherically-Propagated Radio Frequency Communication Channel Performance Data by Way of Dialup Telephone Networks,
P. Ruputz (USN), Electrical Engineering, June 1979, Advisor: Knorr.

The Statistics of Multipath Fading for an Overwater Path at VHF Applied to Communications Links at NUWES, Keyport, Washington,
J. R. Cano (USN), Electrical Engineering, June 1979, Advisor: Knorr.

Acoustic Imaging Processor,
T. E. McCombs, Engineering Acoustics, June 1979, Advisor: Sackman.

Fiber Optic Link Design for an Open-Ocean Shallow-Water Tracking Range,
D. N. Nicholson (USA), Electrical Engineering, March 1980, Advisor: Powers.

A Model for Correcting Underwater Radiated Noise Measurements in the Presence of Surface and Bottom Reflections,
P. D. Ward (USN), Applied Science, March 1980, Advisor: Titus.

An Application of Kalman Filtering to Torpedo Tracking,
T. A. O'Brien, Electrical Engineering, September 1980, Advisor: Titus.

A Pulse Code Modulated Fiber Optic Link Design for Quinault Underwater Tracking Range,
D. A. Anderson (USCG), Electrical Engineering, September 1980, Advisor: Powers.

A Signal Processing Algorithm Based on Multiple Microprocessors for an Underwater Acoustic Imaging System,
LT. R. A. Vermander (Canadian Forces), Engineering Acoustics and Computer Science, December 1980, Advisors: Sackman and Kodres.

An Analog Signal Fiber Optic Link Design for Quinault Underwater Tracking Range,
LT. A. Moraitakis (Hellenic Navy), Electrical Engineering, December 1980, Advisor: Powers.

An Underwater Fiber Optic Linked Video System,
LT. M. Davis (USN), Electrical Engineering, March 1981, Advisors: Powers and Titus.

Fiber Optic Inteference for Computer Peripherals,
D. W. Rowland (USN), Electrical Engineering, December 1981, Advisor: Powers.

A Computer Model of Low Frequency Sound Propagation and Reverberation in Dabob Bay, Washington,
J. B. Miller (USN), Systems Technology, March 1982, Advisor: Wilson.

Serial Data Communication Using an HFBR-0500 Fiber Optic System,
G. F. Thomas (USA), Electrical Engineering, October 1982, Advisor: Powers.

Sub-Bottom High Resolution Sonar Utilizing Non-Linear Acoustic Pulse Self Demodulation,
R. L. Eyman (USN), Engineering Acoustics, P. J. LeStrange (USN), Engineering Acoustics, and A. H. Seeman (Federal German Navy), Physics, December 1982, Advisors: Sackman and Coppens.

Design of a Bit Error Rate Counter and Spread Spectrum System for Evaluation of Fiber Optic Data Links,
H. G. Tolbert (USN), Electrical Engineering, December 1982, Advisor: Powers.

Data Plotting Software for the NPS Electromagnetic Propagation Data Acquisition System,
A. M. Wetzstern, Electrical Engineering, December 1982, Advisor: Knorr.

Ocean Floor Geomagnetic Data Collection System,
A. R. Gritzke (USN), Physics, and R. H. Johnson II (USN), Physics, December 1982, Advisor: Powers.

Implementing Kalman Filtering and Optimal Smoothing for Torpedo Tracking,
J. W. Markevicz (USN), Electrical Engineering, March 1983, Advisor: Titus.

NPS Electromagnetic Propagation Data Aquisition System Upgrade,
J. Frey (USN), Electrical Engineering, September 1983, Advisor: Knorr.

Design and Testing of an SDLC Loop Interface Unit,
S. W. Rutherford (USA), Electrical Engineering, September 1983, Advisor: Powers.

Wavelength Division Multiplexing: An Experiment in Fiber Optic Link Design,
R. P. Lee (USN), Electrical Engineering, September 1983, Advisor: Powers.

A Horizontal Range vs. Depth Solution of Sound Source Position Under General Sound Velocity Conditions Using the Lloyds Mirror Interference Pattern,
R. F. Hudson (USN), Systems Technology, September 1983, Advisor: Burmaster.

Development of Real Time Error Ellipsoids as an Indicator of Kalman Filter Performance,
J. Jaros (USN), Electrical Engineering, March 1984, Advisor: Gerba.

Kalman Filter Torpedo Track Estimation,
R. L. Jones (USN), Electrical Engineering, June 1984, Advisor: Titus.

An Operational Analysis of System Calibration,
H. B. Mutlu (Turkish Navy), Operations Research, September 1984, Advisor: Gaver.

lternative Models for Calculation of Elevation Angles and Ray Transit Times
or Ray Tracing of Hydrophonic Tracking Data,
. D. Main (USCG), Operations Research, September 1984, Advisor: Read.

nalysis of Torpedo MK-46 MOD5 in a Dual Near Simultaneous Launch Tactic
U),, SECRET/NOFORN,
. W. Galatioto (USN), Systems Technology, September 1984, Advisor: Esary.

evelopment of a Modified Time Delay Spectrometry Technique for Underwater
coustic Measurements in a Multipath Environment,
. Brekke (Norwegian Navy), Engineering Acoustics, December 1984,
dvisors: Wilson and Powers.

Remote Bit-Error Rate Counter for Underwater Fiber Optic Communications,
. B. Davidson (USN), Electrical Engineering , December 1984,
dvisor: Powers.

Model to Compare the Probabilities of Hit for the MK 46 Torpedo When
perating with a Free Fall Dive to Search Depth Against the Present Powered
ive to Search Depth (U), SECRET,
. J. Walsh (USN), Operations Research, March 1985, Advisor: Esary.

he Simulation of Remotely Measured Paths of Underwater Vehicles for the
urpose of Monitoring the Calibration of Test Ranges,
. Gygax (USN), Operations Research, September 1985, Advisor: Read.

he Potential for Mutual Interference between the MK 50 and MK 46 Torpedoes
J), SECRET,
. D. Harrelson (USN), Systems Technology, September 1985, Advisor: Forrest.

n Overview of the MK 50 Torpedo from a User's Point of View (U), SECRET,
. M. Morrison (USN), Systems Technology, September 1985,
dvisors: Esary and Forrest.

APPENDIX F

LIST OF STUDENT EXPERIENCE TOURS AND FACULTY VISITS

Experience tours are typically of six weeks duration during the academic quarter cited.

Experience Tour, P. D. Ward (USN), Spring Quarter 1979.

Experience Tour, D. N. Thackery (USN), Fall Quarter 1979.

Experience Tour, R. F. Hudson (USN), Fall Quarter 1982.

Experience Tour, W. M. Morrison (USN), Fall Quarter 1984.

Experience Tour, R. D. Harrelson (USN), Fall Quarter 1984.

Experience Tour, D. T. Biesel (USN), Spring Quarter 1986.

Experience Tour, O. H. Nieman (USN), Spring Quarter 1986.

In addition to student experience tours, faculty working visits to NUWES include project work and classes in statistics by Washburn during the summer of 1975 and project work and classes by Dahl during the summer of 1979. At various times Kildall and (V. M.) Powers taught microcomputer courses and participated in setting up microcomputer laboratories. Sanders and Coppens taught classes in acoustics during two different years. Esary conducted sessions on reliability during a short visit in 1982 and Poock advised on speech recognition applications for several weeks in 1984. This accounting of faculty visits is particularly fragmentary, and omits any number of working interactions at NUWES and at NPS which were not formally recorded.

ENDIX G

T OF FACULTY PARTICIPANTS

The following lists the names and academic department affiliation of ulty members who have participated in the interaction between the two mands since the beginning. The duration of the participation is not given. e members have been associated with the projects almost continuously, others e served intermittently and some have been affiliated for only part of one r.

Department of Mathematics:
A. A. Goldstein, I. B. Russak, C. O. Wilde

Department of Oceanography:
R. S. Andrews, J. J. von Schwind

Department of Mechanical Engineering:
J. Brock, Gilles Cantin

Department of Electrical Engineering:
M. L. Cotton, A. Gerba, D. B. Hoisington, Gary Kildall, J. B. Knorr
C. E. Menneken, G. A. Myers, J. P. Powers, V. M. Powers,
G. L. Sackman, D. A. Stentz, C. W. Therrien, H. A. Titus

Department of Aeronautics:
M. H. Bank

Department of Operations Research:
J. D. Esary, R. N. Forrest, D. Gaver, G. Poock, R. R. Read,
J. B. Tysver, A. R. Washburn

Department of Physics:
A. B. Coppens, W. P. Cunningham, H. A. Dahl, J. V. Sanders,
O. B. Wilson

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Chairman, Department of Mechanical Engineering, Code 69	1
Prof. J. D. Esary, Code 55Ey	2
Prof. O. B. Wilson, Code 61 Wl	2
Naval Undersea Warfare Enginnering Station	
Keyport, Washington, 98345, Attention:	
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Head, Research and Engineering Department, Code 70	1
Head, Technical Operations Department, Code 80	1
Head, Proof and Test Department, Code 50	1
Administrative Department, Code 01	2